BTEC Assignment Brief

Qualification	Pearson BTEC International Level 3 Foundation Diploma in Engineering Pearson BTEC International Level 3 Diploma in Engineering Pearson BTEC International Level 3 Diploma in Electrical/Electronic Engineering Pearson BTEC International Level 3 Diploma in Mechanical Engineering Pearson BTEC International Level 3 Diploma in Digital Engineering Pearson BTEC International Level 3 Diploma in Manufacturing Engineering Pearson BTEC International Level 3 Extended Diploma in Engineering Pearson BTEC International Level 3 Extended Diploma in Electrical/Electronic Engineering Pearson BTEC International Level 3 Extended Diploma in Mechanical Engineering Pearson BTEC International Level 3 Extended Diploma in Digital Engineering Pearson BTEC International Level 3 Extended Diploma in Manufacturing Engineering
Unit number and title	**Unit 27: Static Mechanical Principles in Practice**
Learning aim(s)	**C:** Examine how axial, bending and shear loading affect the design of structural components
Assignment title	Design relating to axial, bending and shear loading
Assessor	
Issue date	
Hand in deadline	

Vocational Scenario or Context	You are a second year technical apprentice in a large manufacturing company producing structural members. Your supervisor is pleased with your understanding of how beams perform as structural members. He has asked you to perform a number of calculations relating to a new project that involves structural components to check that they are fit for purpose in their load carrying capabilities. The calculations relate to a beam that has to span a particular width but it must conform to a number of constraints, minimum radius of curvature and a factor of safety of 5, and it must be capable of maintaining these minimum values across a fairly large range of temperatures given that the beam will be fixed at both ends.
Task 1	You have been given drawings for a complex structure that has components carrying axial, bending and shear loads. These loads have produced stress levels exceeding safe working values and causing structural failure of components. You have been asked to redesign the structure to optimise its configuration whilst also maintaining strength. **To do this:** Your tutor will provide you with a diagram of a structural system that has component parts that are in need of redesign, along with details of the loadings on the system.

	The information your tutor provides will include a minimum factor of safety and a figure for the maximum allowable deflection of the whole system. **You need to:** • Conduct a structural analysis on the major components of the system. You should include: a. calculations to determine the tensile or compressive stress in an axial-loaded simple component; b. calculations to consider the effects of temperature change on one element of the structure, assuming the component has fixed ends. c. Calculations and annotated sketches to determine shear stresses for a range of bolted or riveted joints, including a single shear lap joint and a double shear butt joint. **You then need to:** You should then use your findings from the structural analysis to redesign the structure to optimise its configuration so that it can cope with significant changes in environmental temperature, and make best use of the available materials. To do this you need to: • Carry out calculations to ensure the best use is made of the available materials for the given loading conditions. • Carry out calculations to assess the impact on the integrity of the whole structure from increases and/or decreases in the size of component(s). • Take into consideration features such as factors of safety, strength to weight ratio and the use of high strength materials to ensure the components are fit for purpose. You need to present your findings in the form of a report.

Checklist of evidence required	A report containing mathematical modelling relating to the analysis of the stresses and strains in given structural components.

Criteria covered by this task:	
Unit/Criteria reference	To achieve the criteria you must show that you are able to:
27/C.D3	Optimise the physical parameters of a structure ensuring it is fit for purpose when subject to axial, bending and shear loading.
27/C.M4	Analyse accurately the axial stress produced in a rigidly held complex structural component when subjected to a combination of axial loading and temperature change.
27/C.M5	Develop accurately a design for a complex structure that does not fail when subject to bending and shear loading.
27/C.P5	Calculate the axial stress produced in a rigidly held simple structural component when subjected to a combination of axial loading and temperature change.
27/C.P6	Calculate the maximum bending stress, the factor of safety in operation and minimum radius of curvature for a simply supported beam carrying concentrated and uniformly distributed loads.
27/C.P7	Calculate the maximum shear stress for a single shear lap joint and a double shear butt joint for given loading.
Sources of information to support you with this Assignment	Boyce A., Cooke E., Jones R., Mantovani B., Roberts D., Weatherill B., (2010) BTEC Level 3 National Engineering Student Book (Level 3 BTEC National Engineering), Pearson Educational, ISBN 978 1 84690 754 1 Tooley M. and Dingle L. (2010) BTEC National Engineering, Elsevier, ISBN 978 0 12 382202 4. Websites engineersedge.com/beam_calc_menu.shtml stressebook.com/classical-hand-calculations-in-structural-analysis/ civilengineer.webinfolist.com/structure.htm onlinestructuraldesign.com/calculations